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AD NUMBER

AD872101

NEW LIMITATION CHANGE

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U.S. Army Test and Evaluation Cmd.,
Aberdeen Proving Ground, MD 21005. REL TO:
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AUTHORITY

USATEC ltr, 14 Dec 1970

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1 June 1970

Materiel Test Procedure 3-3-513
U. S. Army Armor and Engineer Board

U. S. ARMY TEST AND EVALUATION COMMAND
COMMON SERVICE TEST PROCEDURE

FIRST AND SUBSEQUENT ROUND HITTING

1. OBJECTIVE

The objective of this Materiel Test Procedure (MTP) is to outline procedures for determining the first and subsequent round hitting capability of direct fire artillery class weapon systems against vertical targets at unknown ranges.

2. BACKGROUND

The ultimate goal in direct fire gunnery systems is destruction of targets in the shortest possible time. For these systems in general and especially those in or on combat vehicles the time element is almost as important as hitting. Since World War II, great strides have been made in the development of hydraulically and electrically powered gun control and turret traversing systems. In combat vehicles this not only enables the gunner to lay his weapon on target quicker, but also permits remote control of the system by the vehicle commander who usually is in a much better position to locate targets and move the weapon to bring them into the gunner's field of view. Other major improvements include range finders for more accurate range determination and computers which automatically transform the range data from the range finder into superelevation for the particular round of ammunition indexed into the system and feeds it into the gunner's sight. However, the single shot unknown range hit probability of most direct fire weapon systems still is such that heavy reliance must be placed on effective hitting with a second or even a third round. The weapon system not only must have the inherent capability of getting a high percentage of first round hits, but the skills required to operate it and obtain second or third round hits after misses must be within the capabilities of the personnel who must use it.

3. REQUIRED EQUIPMENT

- a. Binoculars and Spotting Scope
- b. Appropriate Firing Range
- c. Ambulance with Medical Personnel and equipment
- d. Appropriate Targets
- e. Meteorological Equipment, as required, for:
 - 1) Windspeed and direction
 - 2) Ambient temperature
 - 3) Relative humidity
- f. Boresighting Devices, as required
- g. Qualified Gunner's M1A1 Quadrant
- h. Pullover Gage
- i. Forms for recording data

- j. Stop Watches
- k. Appropriate Standard Ammunition

4. REFERENCES

- A. USAMC Regulation 385-12, Verification of Safety of Materiel from Development Through Testing, Production, and Supply to Disposition.
- B. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- C. FM 17-12, Tank Gunnery, Part Four, Chapter 11, Section III, Nov. 1964.
- D. MTP 2-3-500, Preoperational Inspection and Physical Characteristics.
- E. MTP 3-3-500, Preoperational Inspection and Physical Characteristics (Armament and Individual).
- F. MTP 3-3-501, Personnel Training.
- G. MTP 3-3-503, Boresight and Zero.
- H. MTP 3-3-505, Speed and Precision of Lay.

5. SCOPE

5.1 SUMMARY

This MTP describes the preparation for, and the test firing for determining the first and subsequent round hit capability of vehicle mounted large caliber weapon systems in a direct fire role.

a. Preparation for Test - A review of the Safety Release, a determination of the availability of service personnel and that test materiel is in satisfactory condition for testing, a preparation of the range site, and bore-sighting and zeroing the weapon systems.

b. Test Conduct - A series of tests to determine the first and subsequent round hitting performance of three crews using the weapon system under the following conditions:

- 1) Using the primary sighting system with the vehicle on fairly level ground and the vehicle commander in both the partially exposed and closed hatch positions.
- 2) Same as in step 1) above except that the vehicle will be canted up to 15 degrees to the right and left.
- 3) Same as in step 1) above except that the secondary sighting system will be used.

5.2 LIMITATIONS

The contents of this document are primarily concerned with direct fire, large caliber vehicle-mounted weapons systems. However, by proper selection of procedures and minor alterations in methodology, it could be made usable for other weapon systems.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Safety

The test officer shall ensure that a Safety Release has been received from HQ, USATECOM in accordance with reference 4A and that is is understood prior to commencing testing.

6.1.2 Personnel

a. Ensure the availability of service personnel, representative of those that will operate the weapon system in the field, who have been trained using the procedures of MTP 3-3-501 and are cognizant of:

- 1) Pertinent technical publications for the test item
- 2) Applicable range regulations and standing operating procedures
- 3) Objectives of the test
- 4) Pertinent data required
- 5) Method of obtaining observations
- 6) Method of recording data
- 7) Safety hazards

b. The gunner-vehicle commander teams must have completed the pertinent manipulation exercises described in MTP 3-3-505 and the gunners must have done some firing with the primary armament.

c. Record the following data for test personnel:

- 1) Name and rank or grade.
- 2) Military Occupational Specialty (MOS) and training and experience in MOS.

6.1.3 Inspection

Subject weapon system and vehicle on which it is mounted to the applicable inspections described in MTP 2-3-500 and MTP 3-3-500 recording all pertinent data on the test vehicle, test weapon system and the number of rounds previously fired through the gun and gun barrel.

6.1.4 Ammunition

The test officer shall ensure the availability of sufficient standard ammunition for each weapon to be tested and the following shall be recorded for each type of ammunition:

- a. Number of rounds recorded
- b. Lot number of rounds recorded

6.1.5 Pretest Operations

a. Erect groups of 2.3 meters (7 1/2 ft.) square panel targets around at least range brackets, i.e., one greater, one lesser and one centered

around the zeroing range. Targets will be placed at random distance within each of the brackets. Number and survey the distance to each target. Make a plot of the target area showing the range and azimuth to and the number of each type and size of target for use as a reference in recording test results.

NOTE: 1. Target size, if specified in the QMR, SDR or other official document will take precedence over those cited above.
2. In the interest of realism, and to avoid clues as to range to the target, the target presentation most prominent and visible to the gunner should be varied by any practicable means to produce non-uniform dimensions representing typical combat targets both larger and smaller in area than the specified size. However, specified target dimensions must be maintained for collection of projectile strike information.
3. Since subsequent-round hit probabilities are likely to be influenced by such factors as dust level at the firing site, terrain, profile, and target background conditions, efforts should be made to ensure that these factors are maintained at a level representative of actual conditions.

b. Erect a boresight and zeroing target at the required range for the weapon system and a gridded target at a convenient range for checking boresight alignments as shown in MTP 3-3-503.
c. Place available meteorological equipment near the firing site.
d. With the vehicle on level ground with brakes set, boresight and zero the weapon system as described in MTP 3-3-503 using the round prescribed for zeroing.
e. Aim the weapon system on the gridded target and mark or record point of alignment for each optical sight and the gun barrel.
f. Record the following data:

- 1) Equipment used for boresighting and the setting on each boresight knob or sight upon completion of boresighting.
- 2) Range and azimuth to the target.
- 3) Fire control equipment used for zeroing.
- 4) Ammunition used by type and lot number and the number of rounds fired.
- 5) Final boresight knob or sight setting.
- 6) Distance of Center of Impact of zeroing group from aiming point.
- 7) Angle of site and the point of alignment of each optical sight and the gun barrel on the gridded target.
- 8) Date and time, ambient temperature, relative humidity, wind-speed and direction.

6.2

TEST CONDUCT

NOTE: 1. Testing should begin within one hour after the system has been zeroed unless firing is to be done at night with

artificial light or under low levels of natural-illumina-
tion conditions.

2. All practicable steps should be taken to minimize the effect of range intelligence derived from crew familiarity with the test site. To this end, details of the target arrangement should not be given to the test personnel and the sequence of target engagements should be varied to the greatest extent practicable.
3. The weapon system will be repositioned after zeroing and may be moved between each engagement.

6.2.1 Firing Test - Phase I

With the firing vehicle positioned on fairly level ground, at least three different crews using the primary fire control system in the unstabilized mode and each type of ammunition provided will fire at one designated target in each range bracket until a target hit is obtained or three rounds are fired as follows:

6.2.1.1 Preparation for Firing a First Round

- a. Rotate the weapon away from the target as specified in the QMR or, if not specified, 540 mils to the right or left prior to engaging each target.
- b. Set the range scale on the prescribed battle sight setting.
- c. Index appropriate ammunition on computer.

NOTE: Vehicle commander will be in the partially exposed position at the beginning of this step.

- d. Test officer designates a target to vehicle commander.

6.2.1.2 Firing a First Round

- a. Commander announces "gunner".

NOTE: Time for exercise begins with above announcement

- b. Using his override control, the commander traverses the weapon mount until the target is within the gunner's field of view.
- c. Depending on the location of the rangefinder, commander or gunner ranges on target.

NOTE: 1. The range scale window of the rangefinder shall be masked to prevent range intelligence.
2. If there is not a rangefinder, the commander will estimate the range and announce it to the gunner.

- d. Loader loads ammunition concurrently with steps b and c above.
- e. Gunner makes final lay on center of visible target mass using manual control, if desired, and fires.
- f. Commander and gunner sense strike of projectile loud enough for

the test officer to hear.

NOTE: If first round strikes target, exercise ends and time stops with target strike. If the sensing of the first round is "miss" exercise continues as described below.

6.2.1.3 Firing a Second Round

- a. The loader reloads immediately.
- b. Gunner relay on target concurrently with reloading, using the burst-on-target method (reference 40) and fires.
- c. Commander and gunner sense strike as in paragraph 6.2.1.2.f, above.

NOTE: If second round strikes target exercise ends and time stops with target strike. If sensing of second round is "miss" continue exercise as described below.

6.2.1.4 Firing a Third Round

Repeat steps described in paragraph 6.2.1.3, above.

NOTE: Check boresight alignment periodically by realigning all optical sights and the weapon on the gridded target.

6.2.1.5 Recording Data

a. Record the following for paragraphs 6.2.1.1 through 6.2.1.4:

- 1) Date and time.
- 2) Name of vehicle commander, serial number of vehicle, total miles accumulated and cant of vehicle.
- 3) Name of gunner, number of rounds previously fired through gun barrel, type of ammunition and lot number of ammunition.
- 4) Fire control system used.
- 5) Type of target, distance to target, method of determining range, range setting used, and azimuth to target.
- 6) Results of boresight retention check, when appropriate, and pullover gage readings, when applicable.
- 7) Ambient temperature, relative humidity, and windspeed and direction.
- 8) Description of dust level at firing site, terrain profile and target background conditions.

b. Record the following for each first round fired:

- 1) Amount and direction of deflection layoff.
- 2) Time to acquire target within gunner's field of view.
- 3) Time to load round, time for gunner to make precise lay, fire and projectile to reach target area, and total time for exercise.
- 4) Gunner's sensing and commander's sensing.
- 5) Whether target was hit or missed.

c. Record data as described in paragraph b.3 through b.5, above for each second and third round fired.

6.2.2 Firing Test - Phase II

Repeat Phase I, except that the vehicle commander will be in the closed hatch position throughout the exercise.

6.2.3 Firing Test - Phase III

Repeat Phase I firing against one mid-range target with the weapon canted up to 15 degrees to the right and the left.

6.2.4 Firing Test - Phase IV

Repeat Phases I, II and III using the stabilized mode of control.

6.2.5 Firing Test - Phase V

Repeat portions of Phase I that ammunition supply will permit, using the secondary sighting system.

6.2.6 Firing Test - Phase VI

Repeat portions of Phase I, II and III near the halfway point and near the end of the service test.

6.2.7 Firing Test - Phase VII

Complete a representative portion of Phase I firing at night under low level natural-illumination conditions and under artificial light conditions when the system has this capability.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Personnel

Record the following for test personnel:

- a. Name
- b. Rank or grade
- c. Military Occupational Specialty (MOS)
- d. Training time in MOS
- e. Experience in MOS

6.3.1.2 Inspection

Record the following:

a. Vehicle inspection data collected as described in the applicable sections of MTP 2-3-500.

b. Weapon system inspection data for each weapon, collected as described in the applicable sections of MTP 3-3-500.

c. Number of rounds fired; for each weapon, when applicable:

- 1) Through the gun
- 2) Through the gun barrel

6.3.1.3 Ammunition

Record the following for each type ammunition recorded:

- a. Type of ammunition
- b. Lot number
- c. Number of rounds recorded

6.3.1.4 Pretest Operations

Record the following:

a. For target arrangement:

- 1) Type and size of each target
- 2) Range to each target in meters
- 3) Azimuth to each target in degrees

b. For boresighting and zeroing:

- 1) Equipment used for boresighting.
- 2) Setting on each boresight knob or sight upon completion of boresighting.
- 3) Range to target in meters.
- 4) Azimuth to target in degrees.
- 5) Fire control equipment used for zeroing.
- 6) Ammunition used by type and lot number.
- 7) Number of rounds fired.
- 8) Final boresight knob or sight setting.
- 9) Distance of Center of Impact of zeroing group from aiming point in inches.
- 10) Angle of site in mils.
- 11) Point of alignment of each optical sight and the gun barrel on the gridded target.
- 12) Ambient temperature in degrees Fahrenheit.
- 13) Relative humidity in percent.
- 14) Windspeed and direction in MPH and degrees
- 15) Date and time in hour, day, month and year.

6.3.2 Test Conduct

a. Record the following for each target engagement exercise:

- 1) Date and time in hour, day, month and year.
- 2) Name of vehicle commander and gunner.
- 3) Serial number of weapon.
- 4) Serial number of vehicle and total miles accumulated.
- 5) Cant of vehicle in degrees.
- 6) Type of ammunition.
- 7) Lot number of ammunition.
- 8) Fire control system used (primary or secondary stabilized or unstabilized).
- 9) Type of target.
- 10) Distance to target in meters.
- 11) Method of determining range.
- 12) Range setting used in yards.
- 13) Azimuth to target in degrees.
- 14) Results of boresight retention check, when appropriate.
- 15) Pullover gage readings, when applicable.
- 16) Number of rounds previously fired through gun barrel.
- 17) Ambient temperature in degrees Fahrenheit.
- 18) Relative humidity in percent.
- 19) Windspeed and direction in MPH and degrees.
- 20) Description of dust level at firing site, terrain profile and target background conditions.
- 21) Type of artificial light used, when applicable.

b. Record the following for each first round fired:

- 1) Amount and direction of deflection layoff.
- 2) Time to acquire target within gunner's field of view.
- 3) Time to load round.
- 4) Time for gunner to make precise lay, fire and projectile to reach target area.
- 5) Total time for exercise.
- 6) Gunner's sensing.
- 7) Commander's sensing.
- 8) Whether target was hit or missed.

c. Record data described in step b.3 through b.8 above for each second and third round fired.

6.4 DATA REDUCTION AND PRESENTATION

Summarize test data showing the percentage of first, second and third round hits and the time required to obtain the hits on each different target under each phase of firing and a consolidation of all firing phases.

MTP 3-3-513
1 June 1970

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1 June 1970

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D*Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)*

1. ORIGINATING ACTIVITY (Corporate author) US Army Test and Evaluation Command (USATECOM) Aberdeen Proving Ground, Maryland 21005		2a. REPORT SECURITY CLASSIFICATION Unclassified
		2b. GROUP -----
3. REPORT TITLE U. S. Army Test and Evaluation Command Materiel Test Procedure 3-3-513, Common Service Test Procedure, - "First and Subsequent Round Hitting."		
4. DESCRIPTIVE NOTES (Type of report and, inclusive dates) Final		
5. AUTHOR(S) (First name, middle initial, last name) -----		
6. REPORT DATE 1 June 1970		7a. TOTAL NO. OF PAGES 12
8a. CONTRACT OR GRANT NO. DA-18-001-AMC-1045(R)		9a. ORIGINATOR'S REPORT NUMBER(S) MTP 3-3-513
b. PROJECT NO AMCR 310-6		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) -----
c. d.		
10. DISTRIBUTION STATEMENT This document is subject to special export controls and each transmittal to foreign governments or foreign nationals, -WITH THE EXCEPTION OF AUSTRALIA, CANADA, AND UNITED KINGDOM, -may be made only with prior approval of HQ, USATECOM.		
11. SUPPLEMENTARY NOTES -----		12. SPONSORING MILITARY ACTIVITY Headquarters US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005
13. ABSTRACT This Army Service Test Procedure describes test methods and techniques for evaluating the capability of direct-fire Artillery Class weapons, in first and subsequent round hitting on vertical targets. This procedure is intended for combat vehicle-mounted large caliber weapons systems. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.		

DD FORM 1 NOV 65 1473

S/N 0101-807-6811

(PAGE 1)

UNCLASSIFIED

Security Classification

A-31408

MTP 3-3-513
1 June 1970

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Army Service Test						
Combat Vehicle Mounted Weapons (Large Caliber and Direct Fire)						
First and Subsequent Round Hitting Capability						
Test Procedures						
Test Methods and Techniques						

DD FORM 1 NOV 65 1473 (BACK)

5/N 0101-807-6521

UNCLASSIFIED

Security Classification

A-31409